Longitudinal Treatment Effects Among Cocaine Users: A Growth Curve Modeling Approach

Yih-Ing Hser[1]
Chih-Ping Chou[2]
M. Douglas Anglin[1]
[1] *UCLA Integrated Substance Abuse Program*
[2] *USC Institute of Prevention Research*

Study Purpose

- Secondary analysis on natural history data
- Examine treatment effects among cocaine users
- Apply growth curve modeling technique to model longitudinal treatment effects

Study Design

Sample Sources:

371 cocaine users as part of a large study, from emergency rooms, jails, and sexually transmitted disease clinics in Los Angeles County

Three groups:

1. Reported history of treatment participation and 1st treatment was for cocaine use (N = 145)
2. Reported history of treatment participation and 1st treatment was for drugs other than cocaine (N = 105)
3. Reported never in treatment (N = 121)

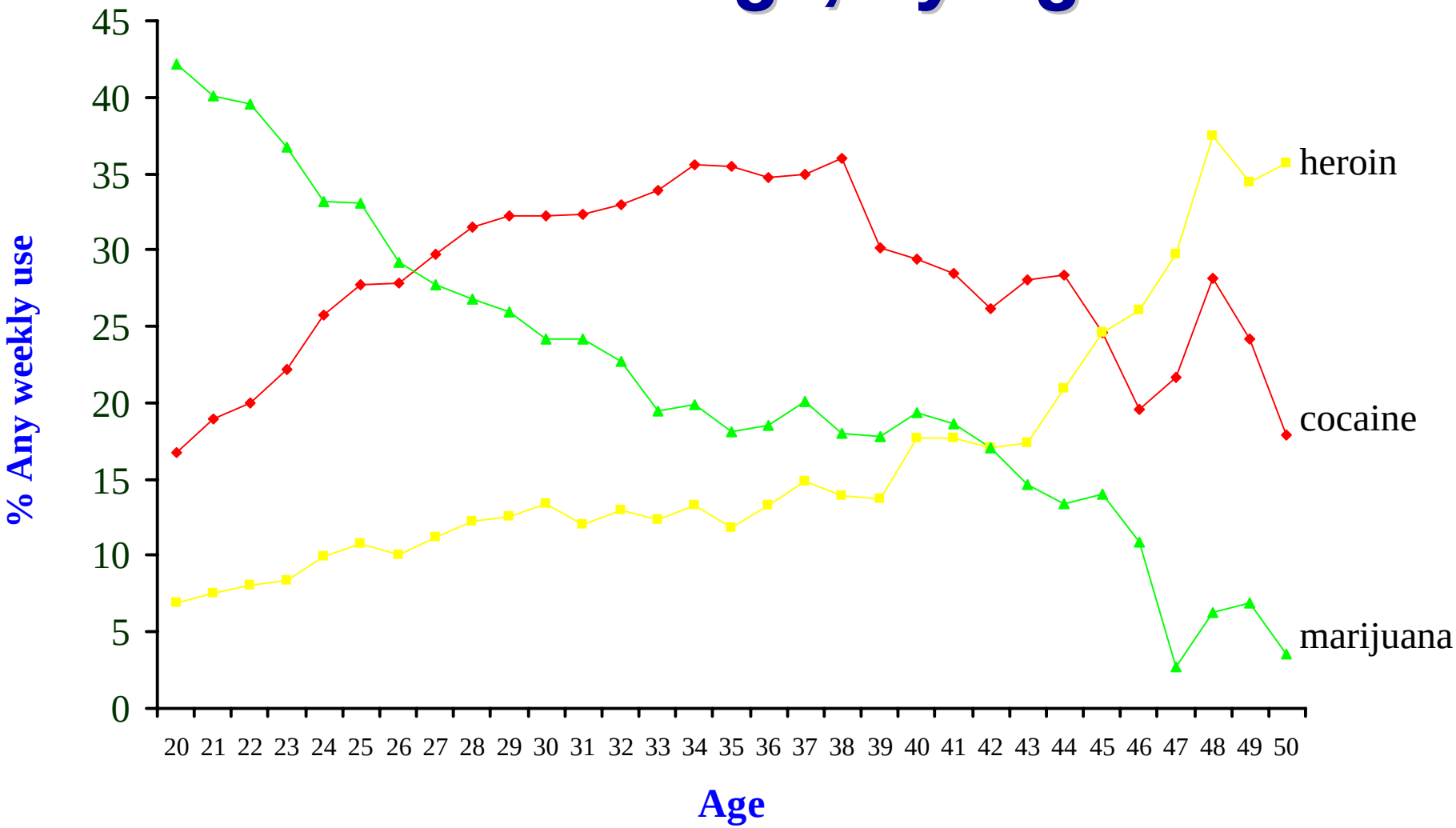
Data Collection Method

- Face-to-face Interview
- Natural History Interview Instrument

Natural History Interview

- Self-report on behaviors/activities in a chronological order starting from 1st drug use until time of interview
- Multiple domains including drug use (e.g., heroin, cocaine, marijuana, alcohol), criminal activities, drug trafficking, employment, etc.
- Quality control

Self-reported Any Weekly Use of Illicit Drugs, by Age



Analytic Strategies

- Descriptive
- Time Series Display
- Growth Curve Model

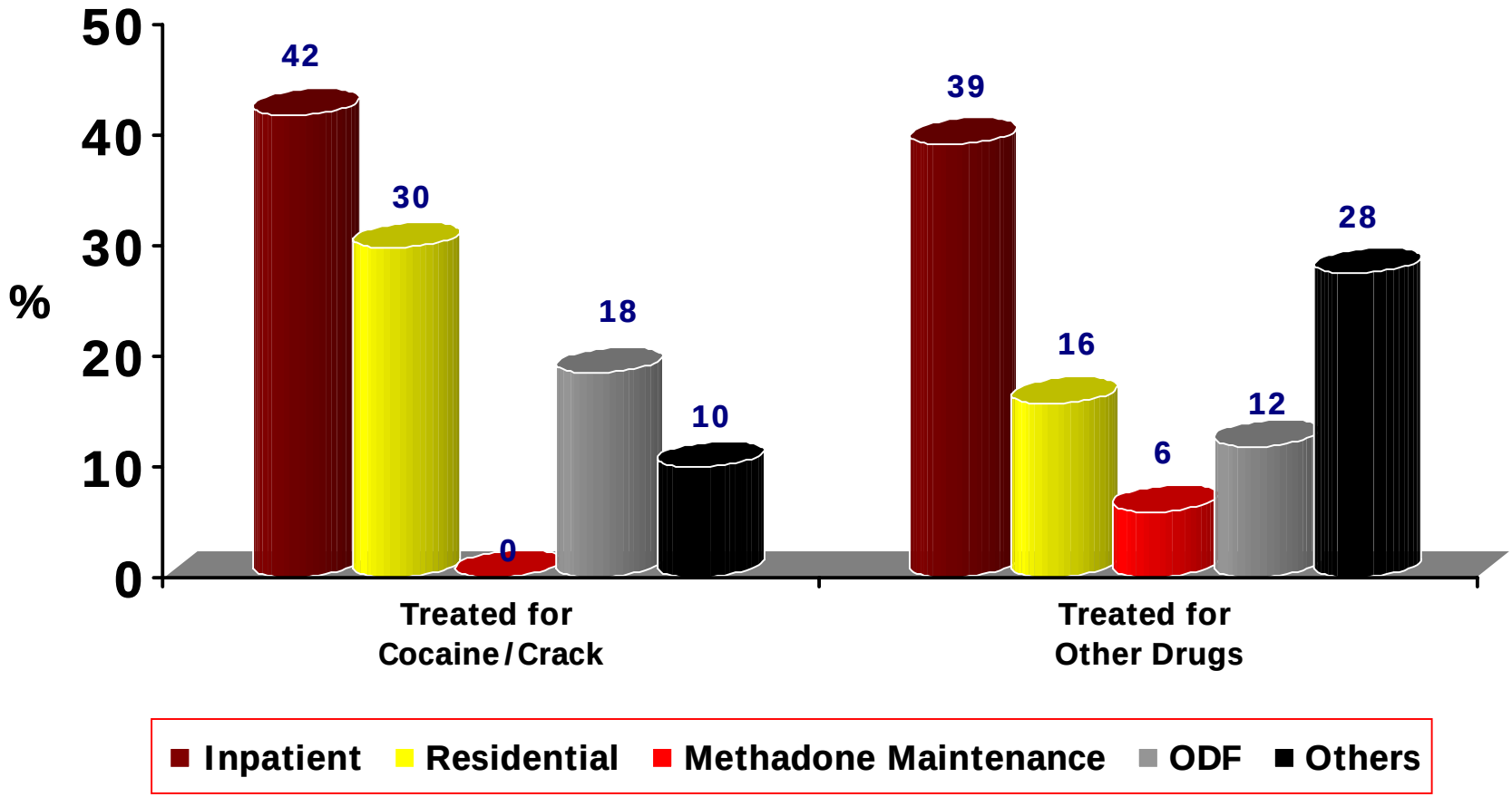
Analytical Data

- 36-month period (12 months prior to the first treatment entry and 24 months afterwards)
- For non-treatment sample, started with 8 years after first cocaine use

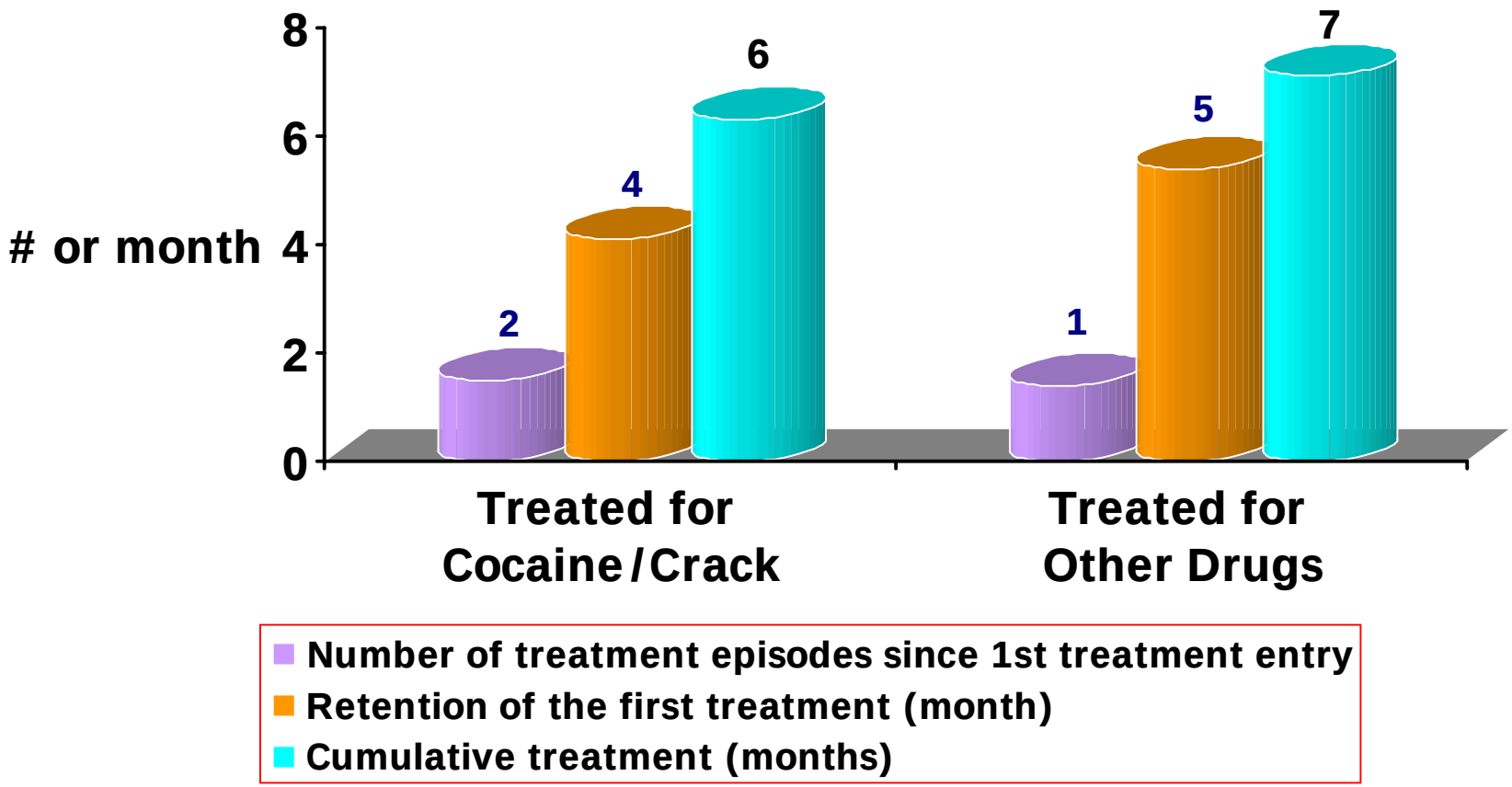
Sample Characteristics

	Treated for Cocaine (N=145)	Treated for Other Drugs (N=105)	Non-Treated Users (N=121)	Total (N=371)
Female (%)	49.0	29.5	25.6	35.8
Ethnicity (%)				
White	13.8	35.2	22.3	22.6
Black	72.4	29.5	47.1	52.0
Hispanic	12.4	34.3	24.8	22.6
Others	1.4	1.0	5.8	2.7
Age at interview	35.4	35.7	35.9	35.7
Recruitment Sources (%)				
STD	24.1	24.8	30.6	26.4
ER	38.6	28.6	34.7	34.5
Jail	37.2	46.7	34.7	39.1

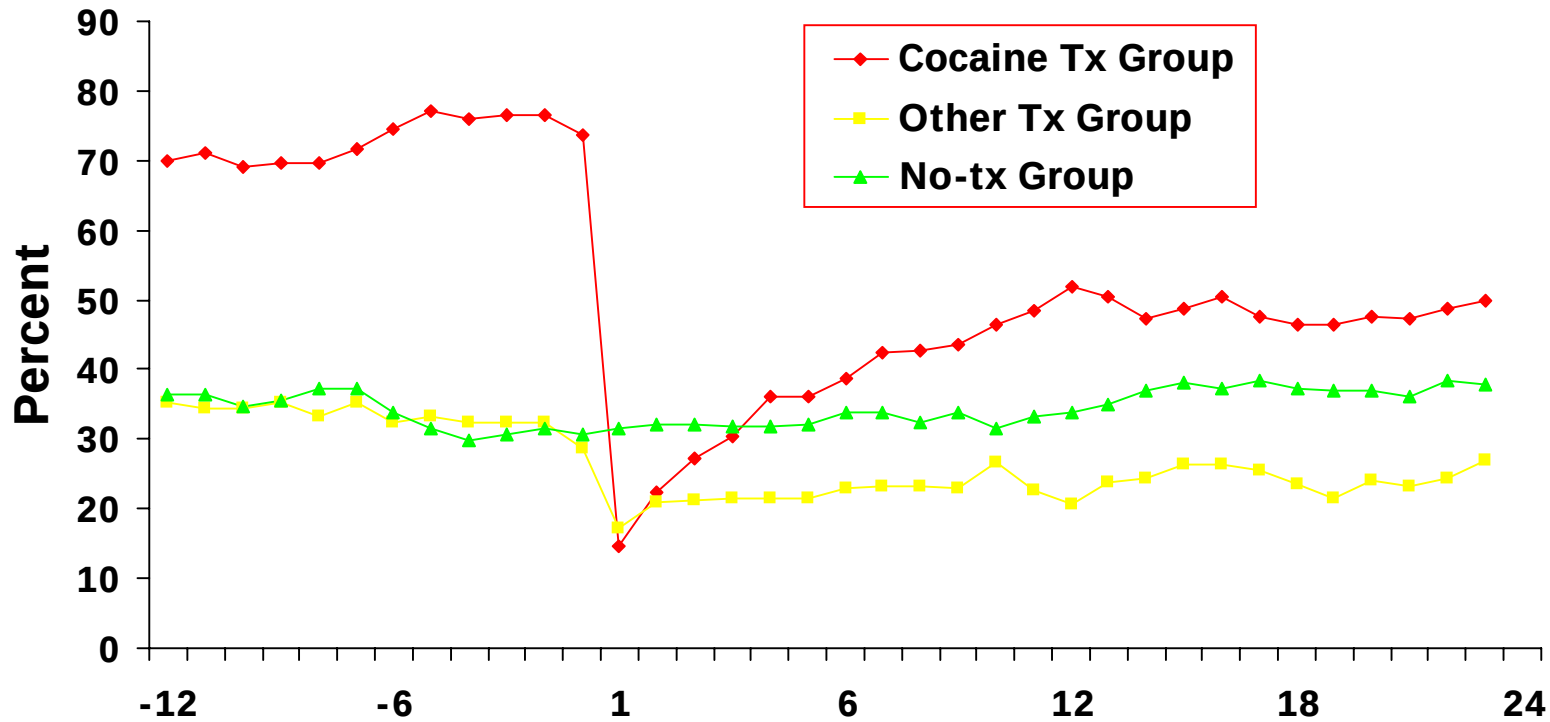
First Treatment by Modality



Treatment Episodes and Retention



Cocaine Use Among Cocaine Treatment and Comparison Groups



Specification of GCM

- A GCM approach consists of models for two levels.
- The Level-1 (or within-individual) model treats repeated measures of outcome as a function of time.
- The Level-2 (or between-individual) model treats parameters in Level-1 model as outcome.

Specification of GCM (continued)

- Most commonly used models for both Level-1 and Level-2 models are regression models.

- Several package computer softwares, such as HLM and MLn, also allows logistic, or survival, model as Level-1 model.

Level-1 (With in-Individual) Model

- The Level-1 Model:

$$Y_{ij} = b_{0j} + t_{ij}\, b_{1j} + e_{ij}, \qquad (1)$$

where y_{ij} represents an outcome measure for subject j at time i ; and

- t_{ij} represents the time of measurement. In GCM, we usually define t_{ij} to be equal to i.

$$Y_{ij} = b_{0j} + t_{ij} b_{1j} + e_{ij} \quad (1)$$

- The Level-1 model represents a growth profile.
- b_{0j} and b_{1j} stand for the growth parameters of interest.
- b_{0j} refers to initial status, and
- b_{1j} refers to growth trajectory, or growth rate.

Level-2 (Between-Individual) Model

- With one predictor for both b_{0j} and b_{1j}, the Level-2 models can be specified as:

$$b_{0j} = \gamma_{00} + \gamma_{01} Z_{1j} + u_{0j}, \quad (2)$$

$$b_{1j} = \gamma_{10} + \gamma_{11} Z_{1j} + u_{1j}, \quad (3)$$

- where Z represents the variable available at the individual level.

$$b_{0j} = \gamma_{00} + \gamma_{01} Z_{1j} + u_{0j} \quad (2)$$
$$b_{1j} = \gamma_{10} + \gamma_{11} Z_{1j} + u_{1j} \quad (3)$$

- γ_{00} and γ_{10} stand for the adjusted means, or intercepts, of b_{0j} and b_{1j}, respectively.

- γ_{01} and γ_{11} are the regression weights for the impacts of Z_1 on initial status (b_0) and growth rate (b_1), respectively.

Evaluating Treatment Effect on Cocaine Use

- Hypothesis: Cocaine users in treatment for cocaine should reduce their cocaine use.
- Hypothesis: Cocaine users who received treatment for cocaine were less likely to use cocaine than those who received treatment for other drugs.

Two-Stage GCM

- Because of the *pre-* and *post-treatment* stages that each subject has experienced, we introduce a *two-stage GCM to* incorporate two growth profiles.

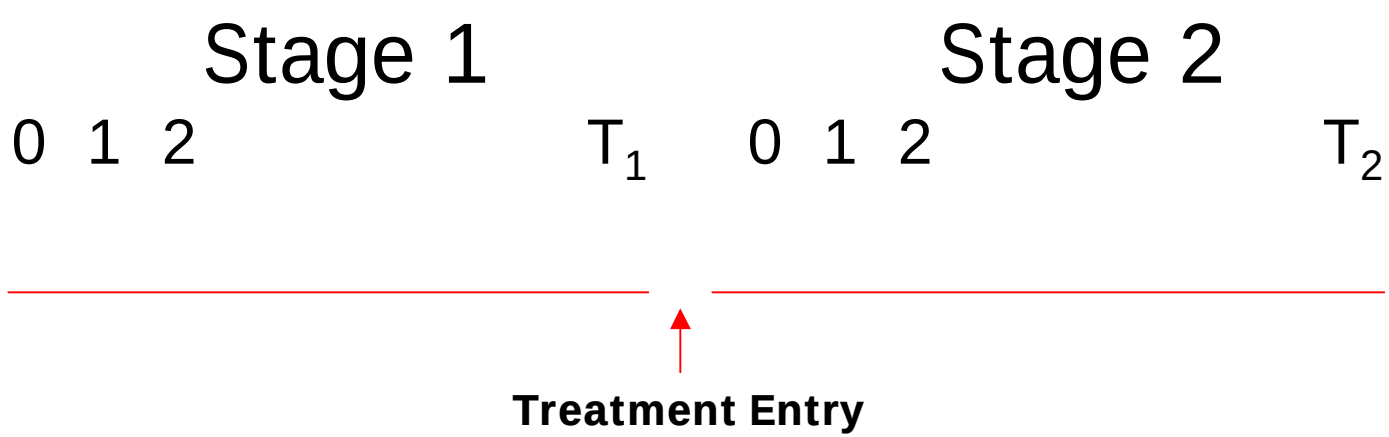
- One initial status and one growth trajectory parameters were specified for each stage.

- The Level-1 Model in Two-Stage GCM is:

$$Y_{ij} = b_{0j} + t_{1ij} b_{1j} + b_{2j} + t_{2ij} b_{3j} + e_{ij} \qquad (4)$$

- t_{1ij} and t_{2ij} in Eq. (4) need to be defined to adequately reflect *time* in *pre-* and *post-treatment* stages.

- Assume that Stage 1 covers time 0 to time T_1, and Stage 2 covers time 0 to time T_2.



- $t_{1\,i\,j}$ takes the value of i (ranged from 1 to T_1) in Stage 1, and 0 in Stage 2.

- $t_{2\,i\,j}$ takes the value of 0 in Stage 1, and the value of i (ranged from 1 to T_2) in Stage 2.

- Type of treatment modality was included in the Level-2 model to investigate the impact of treatment program on the status of cocaine use.

Results of Two-Stage GCM

	Cocaine treatment	Other Treatment
Pre-Treatment		
Initial Status	3.58 (2.25 - 5.69)**	0.93 (0.56 - 1.55)
Growth Rate	1.06 (1.01 - 1.10)*	1.01 (0.97 - 1.05)
Post-Treatment		
Initial Status	0.27 (0.16 - 0.44)**	0.72 (0.45 - 1.16)
Growth Rate	1.03 (1.00 - 1.05)*	1.00 (0.97 - 1.02)

Results of Two-Stage GCM controlling for gender, ethnicity, age 1st use, & recruitment sources

	Cocaine treatment	Other Treatment
Pre-Treatment		
Initial Status	3.41 (2.11 - 5.51)**	1.01 (0.61 - 1.68)
Growth Rate	1.05 (1.00 - 1.10)*	1.01 (0.97 - 1.05)
Post-Treatment		
Initial Status	0.28 (0.17 - 0.45)**	0.66 (0.41 - 1.07)$^{+}$
Growth Rate	1.02 (1.00 - 1.05)$^{+}$	1.00 (0.98 - 1.02)

Cocaine Treatment Group Only

- By considering cocaine treatment group only, we are interested in learning the impacts of AGE 1st Use, and Cumulative Treatment (CUMTX) on the initial cocaine use status and growth rates before and after treatment.

Cocaine treatment Group Only with *time-invariant* covariates

- Level-1 model remains the same as Eq. (4).
- Level-2 models include AGE 1st Use and Cumulative TX as *time-invariant* covariates.

Cocaine treatment Group Only with *time-invariant* covariates

	Age 1st Use	Cumulative TX
Pre-Treatment		
Initial Status	1.03 (0.98 – 1.08)	N/A
Growth Rate	1.00 (0.99 - 1.00)	N/A
Post-Treatment		
Initial Status	0.96 (0.91 – 1.01)	0.90 (0.87 – 0.93)**
Growth Rate	1.00 (1.00 - 1.00)	1.00 (1.00 - 1.00)

Cocaine treatment Group Only with time-variant covariates

- A *time-variant* covariate: Being in Treatment, was introduced to the Level-1 model.

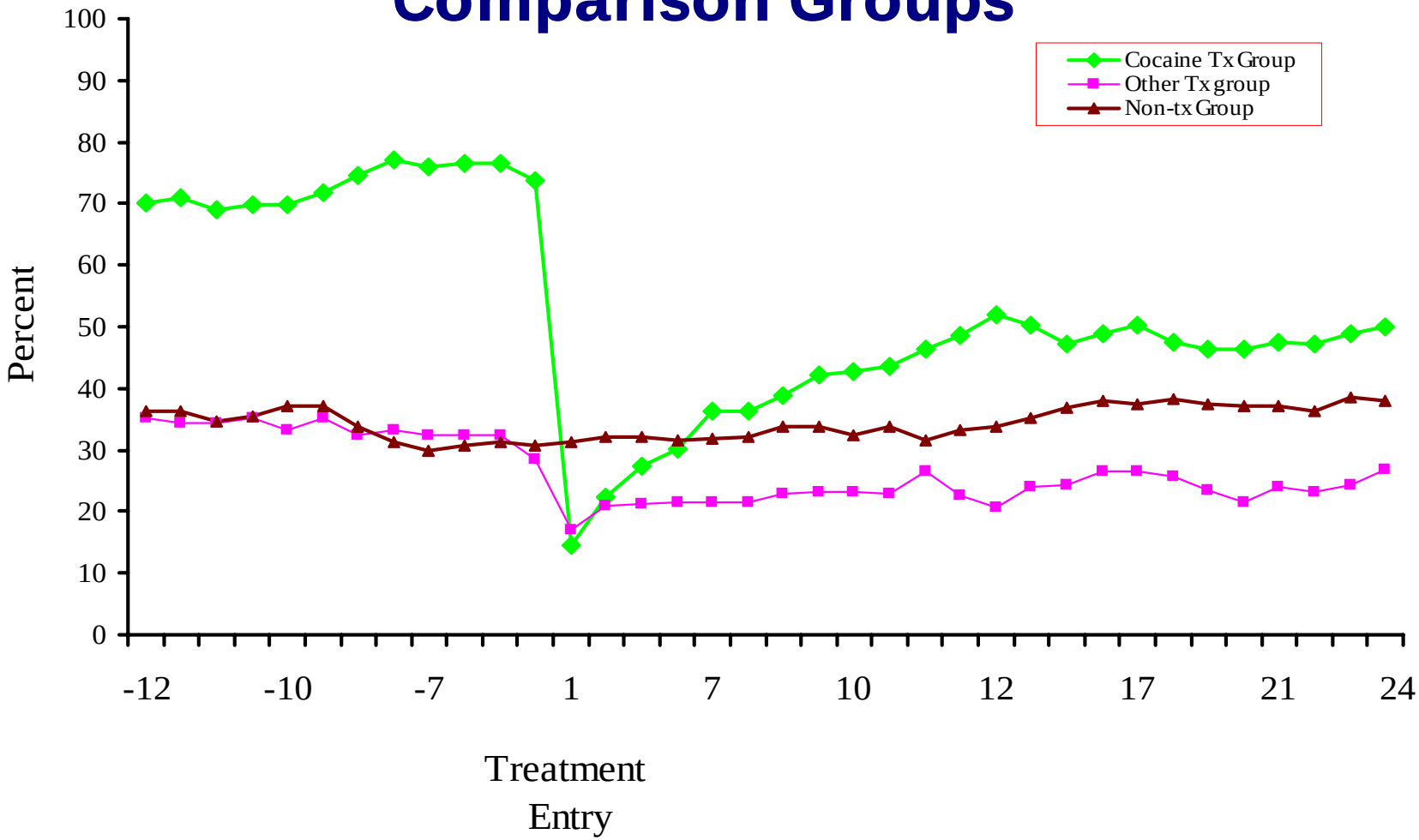
- Level-2 model only consider Age 1st Use as the only time-invariant covariate.

Cocaine treatment Group Only with *time-variant* covariates

- The *time-variant* covariate: Being in treatment, yielded an Odds Ratio of 0.2 indicating a lower rate of cocaine use when subjects are in treatment.

- No other significant impacts have been detected.

Cocaine Use Among Tx and Comparison Groups



Limitations

- Retrospective self-report
- Not a cohort sample
- Treatment utilization was limited among this sample

Concluding Comments

- There was a significant decrease in cocaine use after entering treatment for cocaine
- Longer treatment retention was associated with decreased cocaine use
- Being in treatment is five times more likely to stay cocaine abstinent than not-in-treatment